

# Student Learning Outcomes Assessment Summary

## **Physics, BS**

CNSM/UAF

**2016-2018**

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### **1. Assessment information collected**

Two years ago we completely redid our SLOA plan and rubric. Therefore only a short time record exists for the new instruments developed for evaluation of our program. Therefore this SLOA report will still have gaps in the data that will be filled in over the coming years as all of the instruments are exercised. Also, because of this trends are not yet meaningful.

A list of the major data collection tools follows with some of the major results imbedded:

- 1) *A national physics concepts exam, the FCI, is to be given at the beginning & end of phys 211x, introductory physics, at the end of phys 213x and just before graduation.*
- The Phys 211 class in 2016 showed a pre-test average FCI score of ~46% and a post-test average score of ~ 70%. This gives a normalized gain of 0.44 which is well above the national average (0.23 for traditional courses and 0.44 for interactive courses [Hake98]). In 2017 the pre-test average FCI score of ~47% and a post-test average score of ~ 77%. This gives a normalized gain of 0.56 which is also well above the national average (0.23 for traditional courses and 0.44 for interactive courses [Hake98]). Our pre-test average is consistent with the national pre-test averages (~44% for Universities [Hake98]), suggesting our students are not as poorly prepared as some say (though our variance is rather large suggesting a wide range of preparation and abilities). The post-test averages of 70% and 77% are both well above the 60% threshold for understanding Newtonian mechanics and above the national average. We have not yet separated out the students in this class who are (or become) physics majors but we plan on doing so in the future.
- The Physics 213 classes had an average FCI score of ~71%, again well above the understanding Newtonian mechanics threshold and consistent with the 211 post-test results.

- The Graduation FCI testing results had an average of ~88% which exceeds the standard threshold for Mastery of Newtonian mechanics and is actually better than the average FCI scores for our incoming graduate students.

2) *Student presentations are evaluated with a presentation form.*

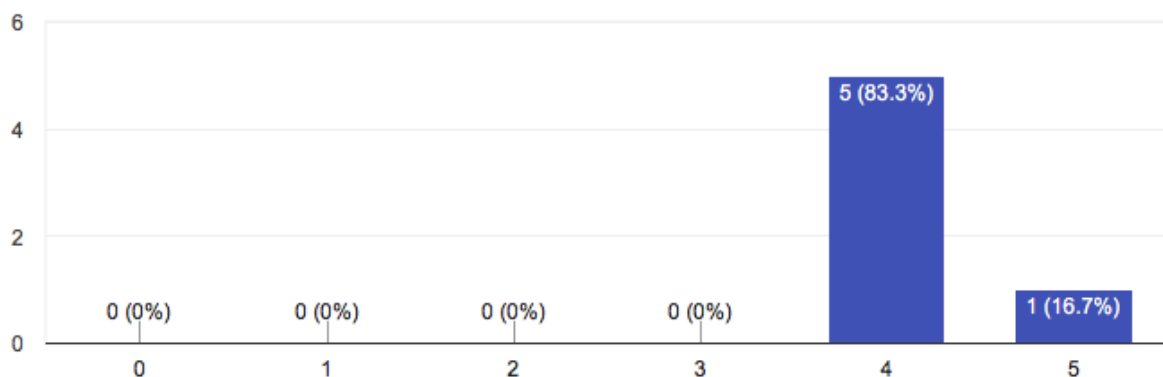
- In the past 2 years Phys 381 presentations, the student scores (from 26 scores) ranged from 1-5, covering the entire range. The average for the questions was about 3.8/5 with the presentation scores slightly higher than the content scores.
- The physics program now has a capstone project with an oral presentation and a written paper as part of the requirements. Because it has just been made part of the program, none of the graduating students this year are required to do the project. However one student graduating did choose to do so and has done the presentation (we have not yet collected all the presentation forms, however those we do have are excellent).

3) *Exit interview evaluated with a written form that can be supplemented with an oral interview.*

### **UAF as a whole provides a stimulating atmosphere for undergraduate study**

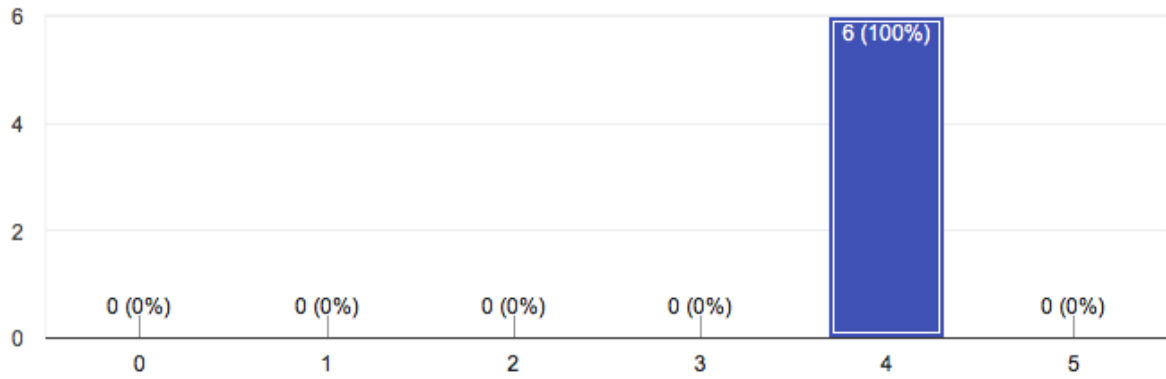
★

6 responses



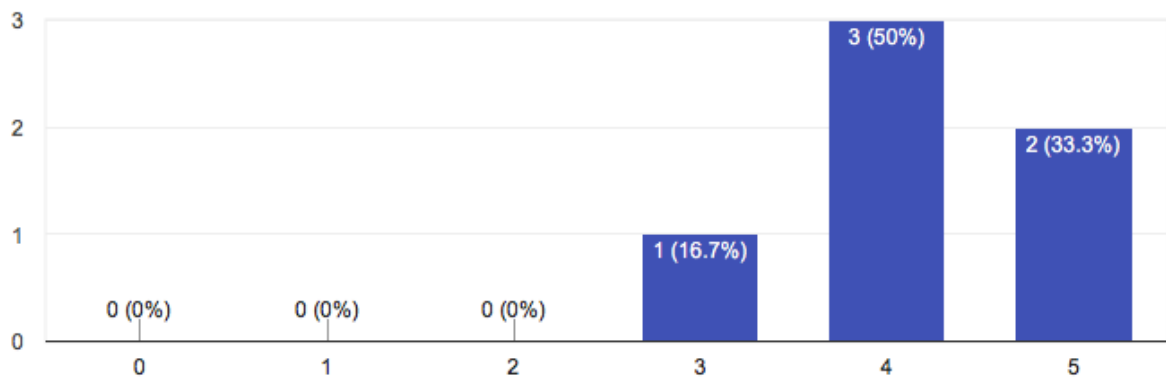
**I am pleased with the curriculum within my degree program \***

6 responses



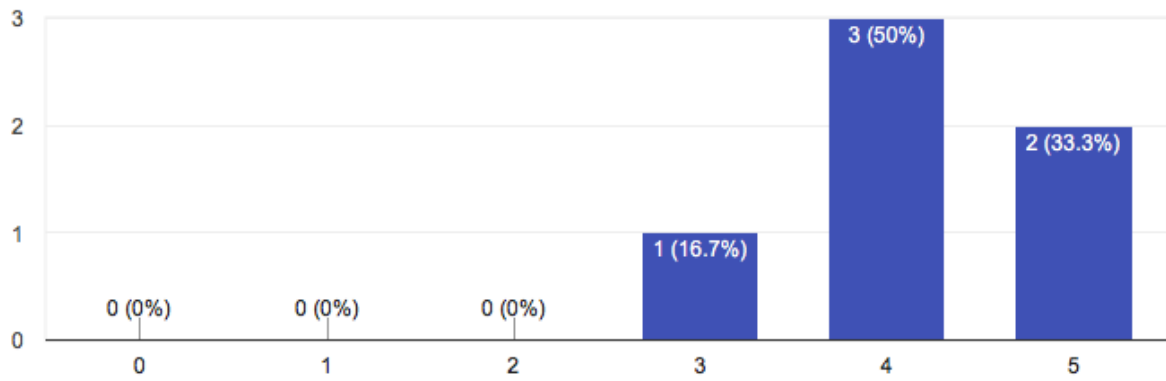
**I can recommend my undergraduate physics degree program to another student \***

6 responses



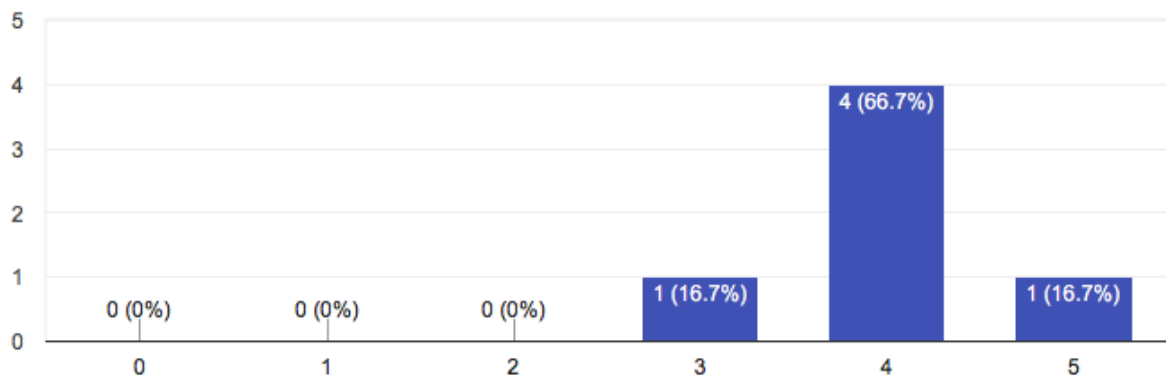
### The quality of instruction in the physics department is high \*

6 responses



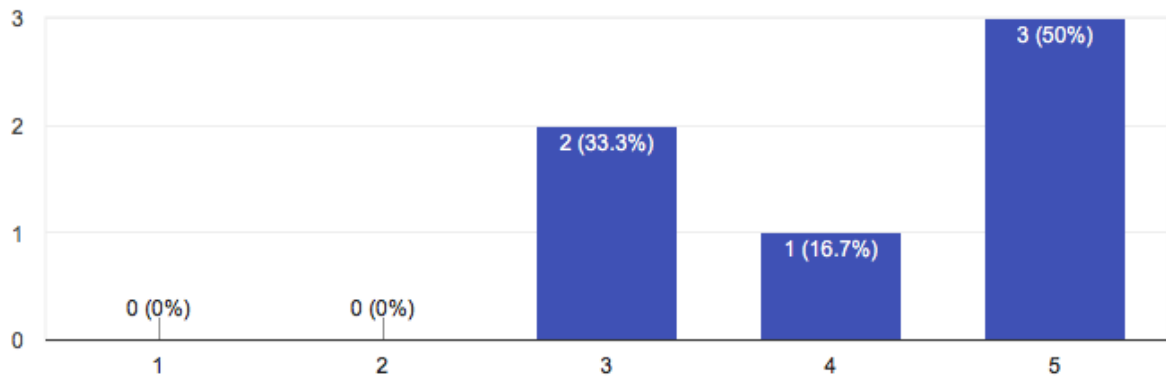
### Faculty members in the physics department provide a stimulating atmosphere \*

6 responses



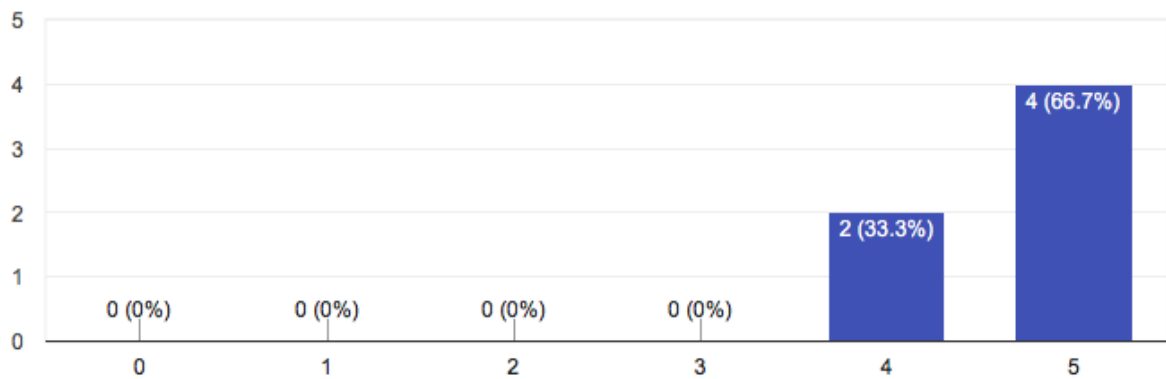
### My advisor was accessible

6 responses



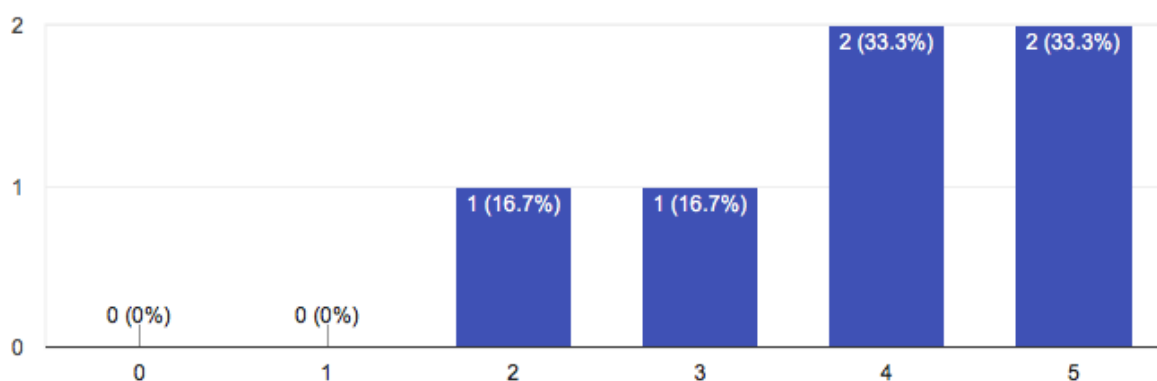
### I learned basic physics principles

6 responses



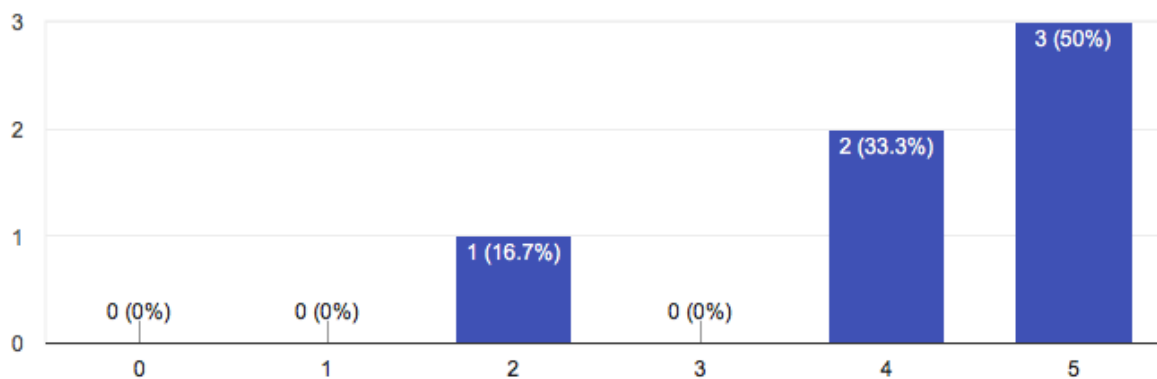
### I learned Computer/Programming skills

6 responses



### I learned public/professional speaking skills

6 responses



A few representative comments were:

“The atmosphere in the department was really great and it contributed a lot to our success. Thank you for a great time!”

“The faculty was extremely friendly and I was able to connect well with the community of physics students both pursuing a graduate and undergraduate degrees. I was given many opportunities to meet others in the field here and abroad given location of

Fairbanks. I feel that there is a lot of opportunities to learn how to use mathematics and basic principles of physics to solve everyday problems but classes could use more emphasis on hands-on learning opportunities. Particular on higher level classes, the practice of gaining a genuine and deeper understanding was often buried with too much emphasis on the mathematics. A physicist should be able to explain a topic in a simple manner before tackling the technicalities of pursuing the exact answer. Giving the students the skill to communicate the essence of a physical phenomena should also be an important feature of the degree, even at higher levels of courses."

*4) Enumeration of number of students pursuing Education at next level ... or ...  
Employment of graduating students into appropriate careers enumerated.*

- Last year (2017) 5 of our 6 students continued on to graduate school. The remaining student is pursuing an industry career.
- This year (2018) at least one of the four students we have graduating in the spring is going on to graduate school, one is preparing for graduate school and one is employed in a technical area.

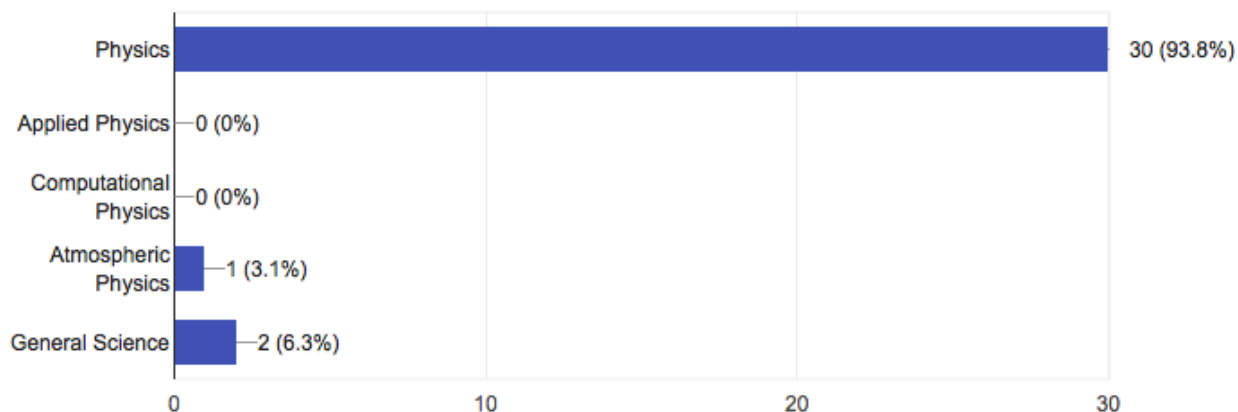
5) Enumeration of the number of students involved in faculty research.

- In the 2016-18 time frame, at least 9 of our undergraduate students have been involved in research in the physics department with a few more doing research in other UAF STEM departments.

6) An annual survey of student perception of their learning in the program.

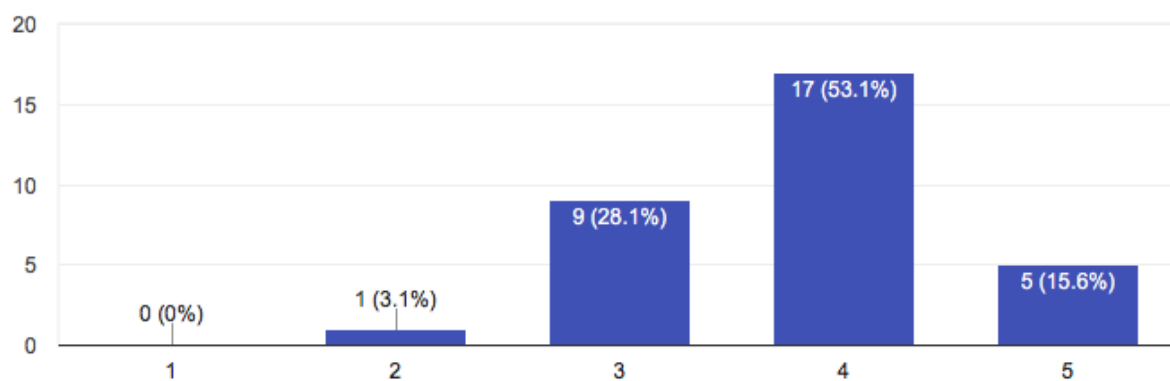
### Degree/concentration you are pursuing

32 responses



### What is your perception of the physics program at UAF? (1= poor to 5=excellent)

32 responses



The mean score was 3.8. over the past 2 years

A few representative comments were:



"Reaching out to the potential students about the diverse uses this degree offers in the workforce afterwards. Getting more enrollment into the department."

"A larger variety of instructors."

"I wish there was a few more Physics degrees available."

"Better and more opportunities for undergraduates, particularly around research. We have the optics and advanced lab. It would be cool to have one also serve as a general undergraduate learning lab. I also feel like there is no one field or area that the undergraduate program really excels. I do like a good general program, but I also don't feel like there is anything pulling out-of-state students to the UAF physics program vs. other schools. Why would an undergraduate pick UAF over another school with a good, small physics department?"

"The department has been very helpful and friendly, showing sincere interest in helping me pursue my degree. This personal interest in the student has been incredibly helpful, and it is in my opinion one of the best strengths of the UAF physics department."

*7) Enumeration of presentations and publications.*

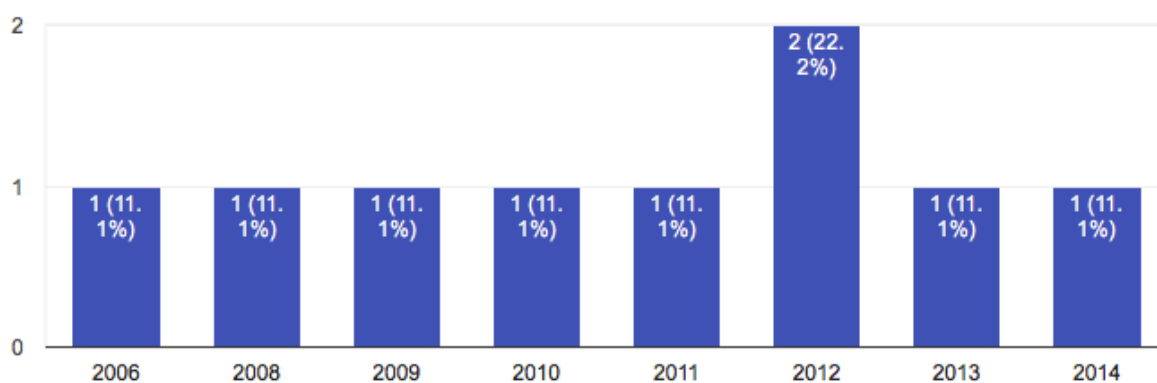
- At least 3 publications
- Our UG students gave at least 15 presentations including national poster sessions and Journal club talks.

*8) A survey of alumni both for their status and their perception of the success of the program evaluated using an alumni survey form - after 1 and 5 years.*

Though there have only been 9 responses so far, there is a great deal of useful information. A selection of which is below:

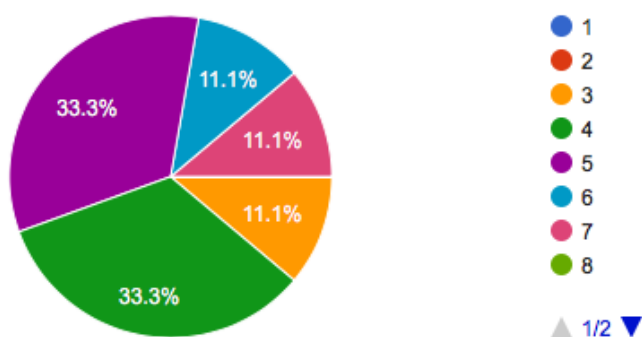
## Year of Degree

9 responses



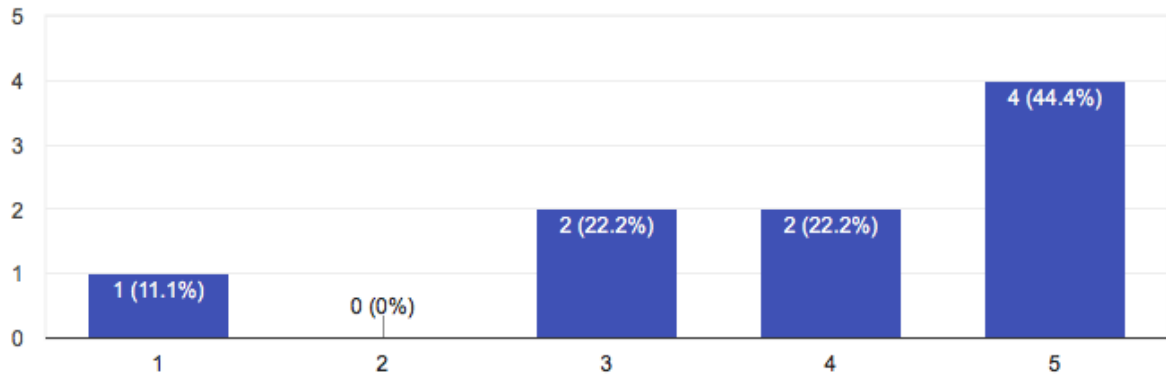
## How many full-time equivalent years of undergraduate study did you complete at UAF?

9 responses



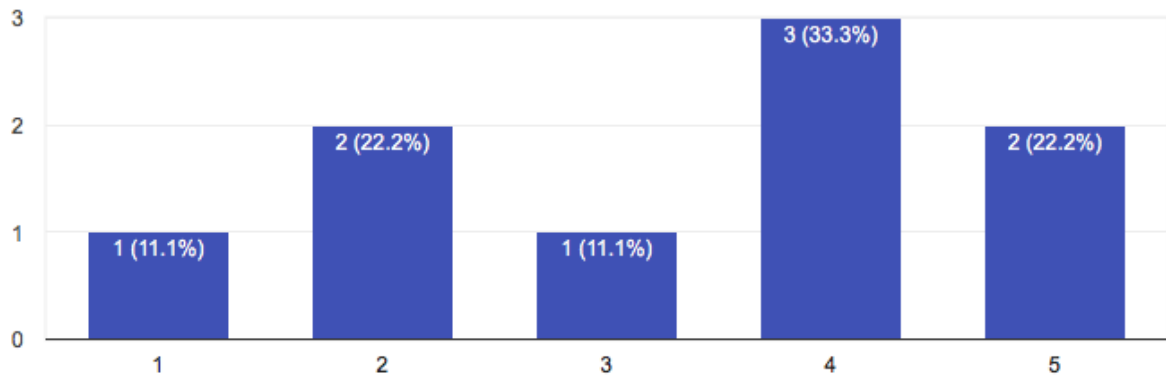
### Frequency of use of "Technical writing"

9 responses



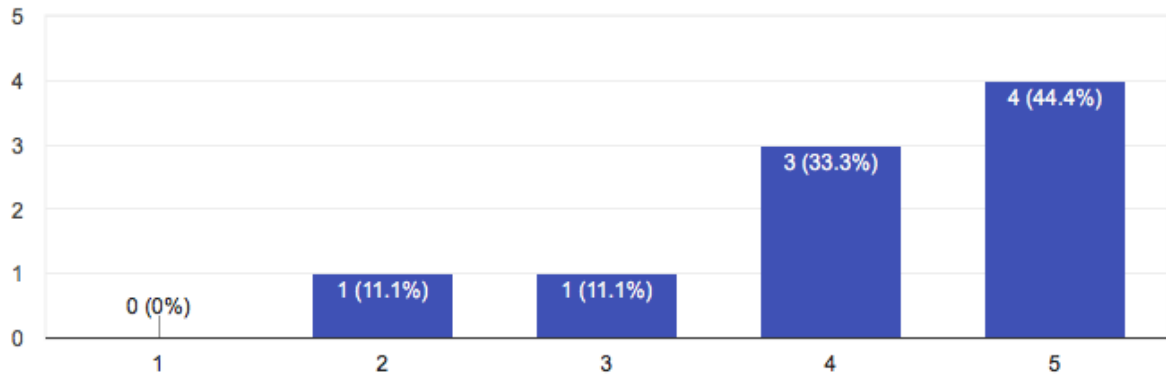
### Preparation for "Technical writing"

9 responses



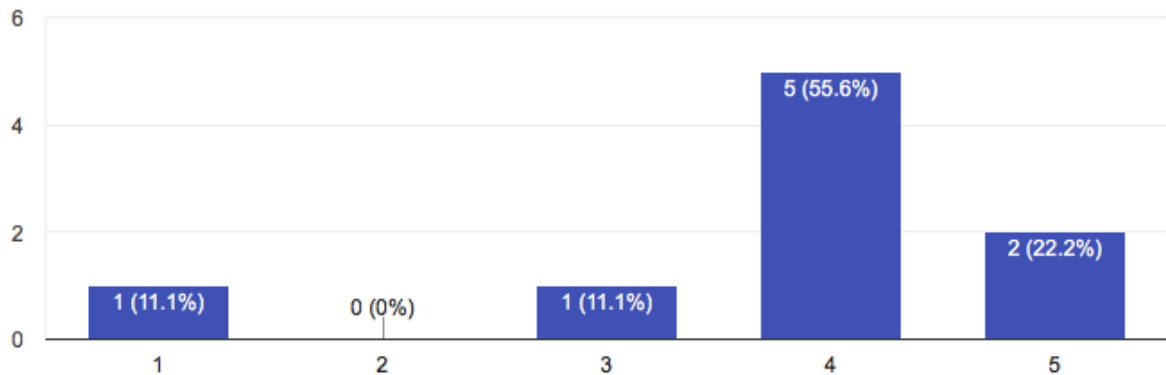
### Frequency of use of "Problem solving/Research skills"

9 responses



### Preparation for "problem solving/research"

9 responses



A few representative comments were:

"The problem is that undergraduate school can prepare you for graduate level courses, but not for research. My difficulties with physics research have basically stalled my graduate career, and may prevent me from getting a PhD."

"Enthusiastic professors who love the material and love teaching are what lay the foundation for our success as students"

"The small class sizes and approach-ability of the faculty really created an interactive learning environment and helped prepare me for grad school & work after."

9) *Outreach presentations (enumerated and or described) and science fair participation (enumerated and or described).*

- Over the last 2 years the UG Physics students have been involved in many outreach presentations including: at least 5 students each year participating in the Science Potpourri, at least 8 students each year organizing and participating in the Star Party, At least 4 students each year participating in the COSMOS presentation.

In addition, direct input from the students on what works and does not work will always be taken.

## **2. Conclusions drawn from the information summarized above**

Overall the program is strong. The FCI results and the number of students continuing on to graduate school suggest that basic physics is being well taught. That said, from the surveys, interviews and comments there are some areas that should be strengthened.

1) More diverse options in physics. 2) Better training in career paths. 3) More training in writing and presentations. 4) More research and problem solving experience.

## **3. Curricular changes resulting from conclusions drawn above**

For the first area of improvement, we are introducing a new program called PhysTEC aimed at allowing a career path for physics teachers. This was specifically in response to the interest expressed by our students as well as the documented Alaska and national demand. For the second area, we will start a new one credit class next spring aimed at exploring career paths, CV writing, interviewing etc. For the third area, we have instituted a comprehensive communication program spanning the entire curriculum. All the students will get instruction and experience in writing, and presenting technical material and material aimed at a general audience. There will be a series of classes in which the writing, web projects and presentations are a significant part of the course. This will culminate with a final project that should incorporate all the aspects, technical writing, public technical speaking and the ability to present the material to a general audience.

Finally, for the fourth point, we have initiated a capstone project. In general this is expected to be a research project with a faculty member. The expectation will be that the student will spend at least a semester doing research. It will be a mentored research project on a physics topic or on a related topic that applies physical problem solving skills. The capstone project must be designed or chosen by the student in consultation with a faculty mentor. The goal is that this will be a “real” research project with the possibility of inclusion on a science presentation or even publication as opposed to a “make work” research project. The faculty mentor must approve the project before work begins. The project will in general include evaluation of data and communication of the study intent, methods, results, interpretation and conclusion in the context of existing literature and knowledge. Finally, it should be noted that all of these initiatives would be greatly facilitated by a less severely constrained faculty size.

**4. Identify the faculty members involved in reaching the conclusions drawn above and agreeing upon the curricular changes resulting**

This summary was collected and compiled by the Physics Undergraduate SLOA committee:

Ataur Chowdhury - chair,  
Chung-Sang Ng,  
Hui Zhang,  
David Newman

It was then discussed and agreed to by the entire physics faculty.

**5. Has your SLOA plan been updated to include assessment of the program's Communication Plan, as required by Faculty Senate motion? (required for baccalaureate programs only)**

The Physics Department has an approved Communication Plan which includes:

- Written and oral presentations in *at least* Computational Physics (Phys 220) that will incorporate
  - Intro. to presentations
  - Written project paper (with feedback on the paper)
  - Oral project presentation (with feedback on the presentations)

- Written and oral presentations in the Advanced lab (Phys 381/382) that will incorporate
  - Written reports with feedback
  - Oral presentations (with feedback) that must include the broader picture/context of the work
- Capstone project
  - A written report with feedback
  - A public oral project presentation (again include broader picture)
- A web project in Intro to Modern Physics (Phys 213) aimed at the Undergraduate level but not aimed exclusively at physics students.

The tools for evaluation of these elements have been agreed to for the communications plan but have not yet been incorporated in our SLOA rubric as we were unaware this was necessary. They will be discussed and added at a faculty meeting in the near future.